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# THE FOOD, AGRIBUSINESS AND RURAL MARKETS (FARM) PROJECT

## EVALUATION OF GRINDING MILLS IN YEI, KAJOKEJI AND MOROBO COUNTIES IN CENTRAL EQUATORIA

Contract No.: EDH-1-00-05-00005-00

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The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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# ACRONYMS AND ABBREVIATIONS

CES	Central Equatoria State
FARM	Food, Agribusiness and Rural Markets
FBO	Farmer-based organization
NGO	Nongovernmental organization
P4P	Purchase for Progress
RSS	Government of the Republic of South Sudan
SFC	Savannah Farmers Cooperative
USAID	United States Agency for International Development
WFP	World Food Programme

# I. EXECUTIVE SUMMARY

As agricultural production increases in South Sudan—and rural and urban households increase their consumption of processed food—grinding mills will offer a valuable service.

Value-addition to South Sudan's key agricultural commodities presents opportunities to diversify commercial efforts beyond the selling of raw commodities to traders, to providing quality products into more expanded markets.

In the case of maize, supporting and strengthening the value chain will be critical to providing incentives for farmers to cultivate for the market, for processors to produce high-quality maize flour, and for retailers to market this flour against other brands.

Only a few individuals are engaged in high-grade flour production, based on the current status of agro-processing at the county level, and their mills are underutilized. The only functioning commercial-level flour producers are Savannah Farmers Cooperative (SFC) in Kajokeji and Yei Mugabe Mill. If these mills and additional mills are to scale up operations, they will require major attention and support to address pricing determination, market penetration, and management and business plans.

## 2. INTRODUCTION

As part of the Ministry of Agriculture-led National Effort for Agricultural Transformation (NEAT), there was a request for a supply of grinding mills to be installed in Central Equatoria State (CES). Before undertaking this investment, there was a consensus that understanding the dynamics of the maize milling industry would be helpful before procurement of more maize mills. This study helps us to understand the current maize milling situation.

Grinding mills have proliferated in South Sudan, due in large part to enterprising individuals marketing labor-saving services to farmers who wish to quickly process their harvested grain. International organizations, such as charities and nongovernmental organizations (NGOs), have also played a significant role in introducing grinding mills throughout South Sudan as an opportunity for individuals and groups to learn business skills, provide community grinding services, and earn income as grinding mill operators. As agricultural production increases in South Sudan, and households increase their consumption of processed foods, grinding mills will function as valuable services to communities.

The Food, Agribusiness, and Rural Markets (FARM) project, funded by the United States Agency for International Development (USAID), seeks to improve agricultural productivity, contribute to increased food security, and enhance the market competitiveness of selected agricultural value chains in the Greenbelt region of South Sudan, covering the productive farming areas of Eastern, Central, and Western Equatoria States. Value-added processing is an integral link in the strategy, based on value chain analysis, to enhance the market competitiveness of the agricultural industry in South Sudan. The long-term vision of the Government of the Republic of South Sudan (RSS) includes an economically vibrant agricultural sector with farmers incentivized through competitive prices paid for quality production. This encourages farmers to produce surpluses for sale to intermediary processors, who in turn transform raw commodities into value-added products that circulate in local and national markets, ultimately improving the terms of trade between South Sudan and its trade partners. This report examines the functions of both rural and urban grinding mills in Central Equatoria State, and analyzes the role of mills and the potential of a small milling sector to contribute to the evolving value-addition process in South Sudan.

### 2.1. METHODOLOGY

This assessment was conducted from June 25 to July 8, 2013, in three counties within the area of operations of the FARM project: Yei, Morobo, and Kajokeji. It focused on distinct points of the more general assessment being conducted at the same time by student interns, who collected basic ownership and operational data. The consultant developed his own line of questioning to expand on the questionnaires administered by the interns (see Appendix I). The consultant used an unstructured approach to interview mill owners, asking searching questions to engage respondents qualitatively and elicit analysis and reflection of the grinding mill business.

### 2.2. PURPOSE OF THE ASSESSMENT

The assessment examined the roles, technical specifications, and opportunities related to grinding mills within the areas of FARM project operations in CES: Yei, Morobo, and Kajokeji Counties. The visit coincided with FARM interns' smartphone assessment of existing grinding mills in the nine payams located within the three counties. These interns, who are currently pursuing agricultural studies at the

Catholic University in Wau, Western Bahr el Ghazal, were instructed to enumerate the grinding mills and collect basic data on the equipment, such as model, output, and operating costs.

The consultant was asked to accompany the interns and evaluate the potential of these grinding mills to increase value-addition to processed maize, and to raise the quality of the maize flour produced to a commercial level, where the final product could compete on quality and price in the open market with imported maize products, especially those from Uganda. There were no target numbers of grinding mills for the consultant to assess, since no one knew how many grinding mills operated in the three counties.

Questions asked by the consultant sometimes overlapped with some of the questions administered in the smartphone survey, but these questions were entry points to probe further into the views and reflections of the grinding mill owners. The consultant also tried to ascertain the plans of grinding mill owners to expand operations. It should be noted that on the questionnaire conducted by the interns, “average low sales, average monthly sales....average high sales” was not input in the smartphone questionnaire.

### **2.3. BASIC FUNCTIONS OF THE GRINDING MILL**

The basic function of the grinding mill is to reduce a grain to its most palatable and digestible form for human consumption through pulverization, fracturing, and shearing.<sup>1</sup> In parts of South Sudan, where grains are milled by hand, a four- to six-foot-long wooden pestle, two to four inches in diameter, with a rounded end, is used to pound the grain, which is placed in a wide mortar-like receptacle hewn out of wood. Milling grain in this manner is laborious and time-consuming and, unfortunately, is done on a daily basis. According to those who perform these tasks, usually women, it can take an hour or more to grind four to six kilograms of grain.<sup>2</sup>

The alternative to milling grain by hand is to pay a local grinding mill operator, who employs mechanized means to perform the same task. Mechanized grinding mills are either driven by an electrical motor (or a generator if no electrical grid is available) or diesel/petrol engine. By mortar and pestle, milling four kilograms of grain takes one hour, but a motorized mill can do the job in minutes. The typical grinding mill pounds, crushes, and pulverizes the grain in whole. Nothing is sorted, separated, or sieved.

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<sup>1</sup> Clarke, Brian. “Small Mills in Africa: selection, installation, and operation of equipment.” Food and Agricultural Organization (FAO) 2006.

<sup>2</sup> The consultant asked this question to women in Northern Bahr el Ghazal during a food security assessment. The women grind sorghum using the traditional method. According to them, there is a preference for sorghum flour prepared in this manner.



# 3. FINDINGS AND ANALYSES OF GRINDING MILL VISITS

From June 26 to July 8, 2013, the consultant, accompanied by six interns from the Catholic University in Wau, Western Bahr el Ghazal,<sup>3</sup> interviewed managers of 23 grinding mills in five payams of the three counties where the FARM project is operating in CES. Overall, data from 74 mills were analyzed. A summary of the profile of the mills is given in Appendix 2. Most of the grinding mills were located in towns, main market centers, and along the roads. A majority of them were installed in 2010. In some cases, the grinding mills were clustered within less than a one kilometer radius. Kajokeji County has the highest concentration of mills.

There is a level of uniformity of function, price, costs of operation, and output that each grinding mill operator performs. There are no significant differences when comparing one mill to another whether they are located along the roads, or competing with other nearby operators in a bustling market. Their basic function is to grind maize, cassava, or sorghum at a charge assessed per kilogram. The fee for grinding varied by payam: 1 SSP=1-3kg; 5 SSP=10kg; 10 SSP=20kg; 12 SSP=25 kg; and 25 SSP=50 kg.

The majority of the mills (66) are individually owned with startup funds coming from personal savings. Only three mills were funded through loans. One mill stands alone—Savannah Farmers' Cooperative (SFC), or SFC Flour Mill. SFC has been supported since 2006 by Cal Bombay Ministries Inc. of Canada, with funding for the construction of its milling facility, procurement of milling equipment, procurement of all heavy equipment (e.g. tractors and related specialized equipment), and provision of SFC's current operating capital. SFC Flour Mill is the premier flour producer in South Sudan.

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<sup>3</sup> Two interns were assigned to each of the three counties under the FARM Project operational area in Central Equatoria State.

**Table 1: Characteristics of Maize Flour Mills in Central Equatoria State and in Yei, Morobo, and Kajokeji Counties**

Kajokeji Counties									
Parameter	Characteristic	CES		Yei County		Morobo County		Kajokeji County	
		Total	Average	Total	Average	Total	Average	Total	Average
Number of maize mills surveyed		74		25		3		46	
Year installed			2010		2010		2008		2010
Number of years in operation			2.7		2.3		2.1		3.1
Ownership	Individual	66	1.0	21	1.0	2	1.0	43	1.0
	Cooperative	3	1.0	1	1.0	1	1.0	1	1.0
	Group	2	1.0	2	1.0	0	0.0	0	0.0
	NGO-donated	3	1.0	1	1.0	0	0.0	2	1.0
Mills with management structure	Yes	18	1.0	8	1.0	2	1.0	8	1.0
	No	56	1.0	17	1.0	1	1.0	38	1.0
Committee members for mills with management structure		136	7.6	84	10.5	14	7.0	38	4.8
Board members for mills with management structure		82	4.6	42	5.3	5	2.5	35	4.4
Source of start-up capital	Own capital	57	1.0	14	1.0	2	1.0	41	1.0
	Group contribution	4	1.0	3	1.0	0	0.0	1	1.0
	Loan	3	1.0	3	1.0	0	0.0	0	0.0
	Other sources	10	1.0	6	1.0	1	1.0	4	1.0

**Table 2: Capacity of Operations for the Maize Flour Mills in Central Equatoria State and the Three Counties of Morobo, Yei and Kajokeji**

Parameter		Central Equatoria State				Yei County				Morobo County				Kajokeji County			
		Total	Average	Maximum	Minimum	Total	Average	Maximum	Minimum	Total	Average	Maximum	Minimum	Total	Average	Maximum	Minimum
Amount of start-up capital		709,200	9,583.8	55,000	400	170,100	6,804.0	16,000	400	6,100	2,033.3	5,000	500	533,000	11,586.9	55,000	1,000
Capacity in Kgs per day	Potential	139,494	1,885.1	20,000	20	8,524	340.9	3,000	20	20,940	6,980.0	20,000	140	110,030	2391.9	9,800	30
	Used	42,761	577.9	8,889	4	6,711	268.4	2,500	4	9,059	3,019.7	8,889	20	26,991	586.8	6,750	25
Operating costs per month	Fuel	144,190	1,975.2	56,733	6	21,936	914.0	3,000	40	3,360	1,120.0	3,000	60	118,894	2,584.7	56,733	6
	Oil	18,938	259.4	4000	4	9,009	375.4	4,000	32	1,470	490.0	1,000	20	8,459	183.9	2,222	4
	Service	32,731	536.6	12,260	3	9,050	476.3	1,500	50	1,860	620.0	1,200	60	21,821	559.5	12,260	3
	Labor	45,415	709.6	7,000	10	19,723	939.2	40,000	10	9,000	3,000.0	7,000	1,000	16,692	417.3	7,000	25
	Vehicle hire	22,601	1,076.2	15,000	4	4,513	410.3	1,000	10	15,790	5,263.3	15,000	190	2,298	328.3	1,000	4

Parameter		Central Equatoria State				Yei County				Morobo County				Kajokeji County			
		Total	Average	Maximum	Minimum	Total	Average	Maximum	Minimum	Total	Average	Maximum	Minimum	Total	Average	Maximum	Minimum
Grade one flour (Kgs)	In store	650.6	162.7	500	20	570	190.0	500	20	80.6	80.6	80.6	80.6	0	0.0	0	0
	For sale	335	111.7	200	55	280	140.0	200	80	55	55.0	55	55	0	0.0	0	0
	Sold	545	181.7	400	55	490	245.0	400	90	55	55.0	55	55	0	0.0	0	0
Grade two <sup>4</sup> flour (Kgs)	In store	4,482	640.3	3,000	2	200	200.0	200	200	620	310.0	500	120	3,662	915.5	3,000	2
	For sale	4,371	624.4	3,000	1	150	150.0	150	150	600	300.0	500	100	3,621	905.3	3,000	1
	Sold	47,275	6,753.6	46,500	1	125	125.0	125	125	74	37.0	50	24	47,076	11,769	46,500	1
Grade three flour (Kgs)	In store	595	119.0	300	30	595	119.0	300	30	0	0.0	0	0	0	0.0	0	0
	For sale	470	94.0	300	25	470	94.0	300	25	0	0.0	0	0	0	0.0	0	0
	Sold	603	120.6	300	23	603	129.6	300	23	0	0.0	0	0	0	0.0	0	0

Source: FARM Project field survey, 2013

<sup>4</sup> Grade 2 flour is not suitable for long-term storage and that is why it was sold in large quantity as compared to Grade 1 and 3 flour.

The consultant inquired about those non-functioning, locked, yet operational grinding mills since they were not noted on the smartphone questionnaire, but no further information was available to explain why these grinding mills were not functioning.<sup>5</sup> <sup>6</sup> Out of the 121 grinding mills visited by the interns, data was collected on 74 of these mills. Only eight (six in Morobo and two in Yei) were established through organizations. The majority are privately owned and set up through the owners' personal means.

The student interns are currently embarking on expanding their assessments to payams outside the operational area of the FARM Project. Appendix 2 contains field notes and operational data of the grinding mills. With respect to any challenges experienced by the interns, two of them expressed challenges in interviewing the mill operators, since the operators were reluctant to release any information about their mills. The interns in the other counties seemed to encounter less resistance from mill owners in contributing information. One challenge observed by the consultant was not finding owners present at their mills, even during work hours.<sup>7</sup> The consultant and the interns often had to wait for as long as an hour before conducting an interview. As already mentioned, those owners not present were not included in the assessment, and because of logistical limitations, the interns could not backtrack the next day and try to interview these owners.

The grinding mills visited were located in towns, main markets, and along the roads throughout the payams, and sometimes clustered within less than a one kilometer radius. For example, in Yei market, the consultant and the interns came across four grinding mills in immediate proximity to one another. In Mugu Payam, Yei County, four grinding mills were within a five-minute walk of each other. In Otogo Payam, the consultant and the Agricultural Commissioner of Yei County, Mr. Edmond Taban Gogo, were able to locate 19 known grinding mills; Mr. Gogo informed the consultant of more grinding mills farther in the interior of the payam and estimated an average of two grinding mills per boma at 22 bomas (i.e., 44 grinding mills).

**Table 3: Storage and Horsepower Capacity of the Flour Mills**

State/County	Measure	Storage Capacity (Kg)		Horse Power
		Grain	Flour	
Central Equatoria State	Total	55,021	52,202	1,252
	Average	3,439	4,016	18
	Maximum	45,000	40,000	38
	Minimum	1	2	2
Yei County	Total	160	2,107	356
	Average	20	301	15
	Maximum	70	2,000	38
	Minimum	1	2	2

<sup>5</sup> On 28 June 2013, the consultant interviewed one of the operators of a grinding mill owned by St. Augustine Church in Otogo Payam of Yei County. The operator said that they offered free milling and only asked for donations for operational costs. The grinding mill during peak season served 200 people/day and ran between 15 and 19 hours/day.

<sup>6</sup> The interns noted five grinding mills that were not operating were donated by organizations.

<sup>7</sup> The hours of operation usually occur in the afternoon when the grinding mill owners return from their fields.

State/County	Measure	Storage Capacity (Kg)		Horse Power
		Grain	Flour	
Morobo County	Total	1,100	9,510	57
	Average	550	3,170	19
	Maximum	600	9,000	32
	Minimum	500	10	2
Kajokeji County	Total	54,261	41,085	871
	Average	7,752	10,271	21
	Maximum	45,000	40,000	32
	Minimum	1	25	2

Source: The FARM Project Field Survey, 2013

Although these grinding mills have generally very low capacity, they contribute to import substitution of maize flour from Uganda. The grade of meal currently produced is grade two, so there is potential to increase the level of value addition by raising production to grade one. Even at this minimal capacity, at the reported operating costs, the mills contribute to the local economy of their payams.

### 3.1. PROFILE OF A GRINDING MILL OPERATION IN CENTRAL EQUATORIA STATE

Through interviews with multiple grinding mills and owners, the consultant concluded that there is a level of uniformity of function, price, costs of operation, and output, with no significant differences when comparing one to another, whether they are located along the roads or competing with other nearby operators in a bustling market. Mills' basic function is to grind maize, cassava, or sorghum at a charge assessed per kilogram. The following table contains a business profile of a typical grinding mill operator, as observed by the consultant (see Table in Appendix 2 for sample profiles of grinding mill operators visited<sup>8</sup>).

**Table 4: Sample Profile of a Grinding Mill Operator in Central Equatoria State**

Typical Grinding Mill Operator Profile	
Form of Business Organization	Owner-operated, privately owned
Services Rendered	Grinding or milling only; typically mills cassava, maize, sorghum
Days of Operations	Monday through Saturday
Number of Hours Open for Business/Day	On average 2 to 4 hours in non-peak season; 8 hours or 10 hours in peak season. The 2 to 4 hours is mainly milling time. The official opening hours may include waiting time since some millers wait until they have accumulated a certain amount of grain that justifies turning on the mill.

<sup>8</sup> There is also one profile of a trader who sells Ugandan flour.

Maximum Capacity in Kg/Day	1,000 kilograms
Current Average Daily Output	300 kg/day (based on assessment.)
Estimated Milling Rate/Hour	50 kg = 30 minutes; 10 kg = 10 minutes
Charge/Fee	1 SSP=1-3 kg, 5 SSP= 10 kg, 10 SSP=20 kg, 12 SSP = 25 kg, and 25 SSP= 50 kg (May vary from payam to payam.)
Quality of Output	Grade 3 maize flour (i.e., includes bran); flour primarily ends up for household use, but a few customers sell this flour in the local market
Estimated Average Daily Fuel Use	2L/100kg; Operators consume on average 5L/day; this may vary depending on condition of machine or engine type (generator or Nissan 4 cylinder engine).
Labor Requirements	Owner-operators may employ up to four workers with a labor rate ranging from 45 SSP to 600 SSP/month.
Estimated Gross Monthly Revenue	Low-end range: 100 kg x .50 SSP x 21 days=1,050 SSP High-end range: 600 kg x .50 SSP x 21 days=6,300 SSP

In addition to the business profile above, the consultant found grinding mill owners possess more or less the same type of grinding equipment with respect to specifications and brand. Specifications:

- Chinese-made from manufacturers such as Chang Fa, AMEC, and Yang Dong<sup>9</sup>
- 20 horsepower; 2200r/minute; 9.7 to 14.3 kW<sup>10</sup>
- Diesel
- Hammer mill

A few configurations differed from the above, including two grinding mills in Kajokeji that were powered by 4-cylinder Nissan engines. Other operators used Lister generators to power the mills, including the grinding mill at St. Augustine Church in Otogo payam, which was not operating.

Based on visual examination, the conditions of the grinding mills appeared functional and normal. Since milling grain is generally dusty, it is difficult to assess the condition of a grinding mill based solely on outward appearance. But when a few of the mills were actually in use, the motors seemed to be running smoothly and there were no back fires or sputtering engine noises. A few operators had well-organized and well-kept shops, such as Khatya in Mugu Payam, where it appeared that the owner actually swept his shop and dusted off the soot from his machine. It seemed that the privately owned operators kept better care of their equipment. The consultant noticed that one grinding mill operator, who received his equipment through an organization, had pipe breaks at the welds and his equipment did not seem functional even though he claimed that he was grinding every day. A simple solution to repair this would have been to duct tape the joints. This is not a blanket indictment against grinding mills given by

<sup>9</sup> According to one of the interns in Morobo County, practically all the grinding mills they assessed were manufactured by the Yang Dong company.

<sup>10</sup> 1 kW= 25-30 kg production per hour.

organizations, as a cooperative<sup>11</sup> in Morobo County was given a grinding mill, which they have since been operating in good condition and have even used proceeds from flour sales to purchase another grinding mill and a rice huller.

When asked if these mills had any capabilities beyond their current and existing use, operators replied that their machines only grind. When asked if these grinding mills could hypothetically be modified to produce flour, the owners said that these mills are what they are. They only grind, and produce what is rated on the market, at best, as Grade 3 flour, regarded as low-quality with a short shelf life.<sup>12</sup>

Some mills may not even qualify as being suitable for processing food for human consumption. (The first grinding mill visited by the consultant in Yei market was labeled as an animal feed mixer.) In general, no one knows how much contaminant (e.g., metallic discharge, debris, or dust) is present in the product from these mills.<sup>13</sup> The flour that is produced circulates in the open market.

When asked about producing their own flour, only two grinding mill operators expressed interest: the cooperative from Morobo mentioned above and Twine Mutane, an individual grinding mill operator in Kajokeji, who is actually in the process of purchasing flour milling machinery. Both grinding mill operators seemed rather enterprising; the one in Kajokeji appears to have a good handle in marketing as he was the only one to mention to the consultant the distinguishable taste difference between locally produced flour and that of imported Ugandan flour. The cooperative expressed the need for financial support to purchase flour-making equipment. Both operators wanted to produce higher-grade flour for the local market. For some mill owners to whom this question was posed, the question may not have been well understood or perhaps was not translated clearly. The majority of operators replied or gave the impression that they were only interested in grinding Grade 3 meal.

### **3.2. EVALUATION OF THE FLOW OF MAIZE THROUGH THE MARKET CHAIN**

Maize is a traditional annual crop grown in most of the Greenbelt of South Sudan, almost exclusively by small-scale farmers for both home consumption and income generation. Maize is an important part of the farming system. It is grown in pure stand, inter-cropped, and in association with other crops. Given the free market in maize, the main issues do not concern policy, institutional, and regulatory matters, but relate to the lack of a formal maize marketing structure. Resolution of these issues could significantly improve farmers' incomes and their move towards commercial agriculture.

Maize produced in South Sudan is mainly consumed domestically and purchased for institutions, such as prisons, schools, and hospitals. Another market for maize in South Sudan is the World Food Programme (WFP) Purchase for Progress (P4P) program, which enhances the productivity and competitiveness of farmers by offering a market outlet to farmer-based organization (FBOs) and traders. P4P builds local capacities to process and store grain and manage warehouses, while facilitating access to credit through guaranteed contracts. Another P4P focus area is the development of market infrastructure, i.e., establishing a network of primary warehouse facilities to support the collection, processing, and storage of grain in selected areas.

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<sup>11</sup> The name of the cooperative is "Locator."

<sup>12</sup> The maize kernels are ground whole; the bran and endosperm are not separated and there is uncertainty as to whether or not the person having her maize ground has removed any dust or debris.

<sup>13</sup> During one of the visits, the consultant witnessed one lady load a bucket of grain that had a few nails mixed in the grains, which ripped through the grinder, causing the worker to find the shreds of nails in the grinder.



These P4P warehouses will be used as platforms for grain purchases via cash on delivery (or as a cereal community bank) and for promoting the establishment of commercial extension services providing inputs or tools to the farmers (World Food Programme, October 2012).<sup>14</sup> In two years, WFP plans to directly impact 4,100 farmers, reaching 15 farmers' organizations and six small traders. It will purchase 3,500 metric tons of grain by the end of 2012; in 2013, it aimed to purchase 100 percent of its maize and sorghum locally. WFP's main activities are forward contracting, direct contracting, and adjusted tendering.

The next question was to investigate the market flow of the raw maize from farm gate to the final retail outlet. Given time restrictions during this visit, the questions were posed to the FARM Project's Agriculture Production Coordinator in Yei, Mr. Simon Pitia Wani, and the Cooperative Program Coordinator, Mr. Augustine Bullen. Both said dried, shelled maize is typically purchased by traders who transact with the farmers on market days; afterwards, the traders transport the grain to the market where they sell it to institutions such as schools or hotels, as well as through retail channels. Maize from retail sales ends up in individual households who grind the grain for their own consumption. The grain is generally not processed into a higher value-added form, such as quality Grade 1 or 2 flour to sell on the open market.

### **3.3. CONCLUSION: FEASIBILITY OF EXISTING GRINDING MILLS AS VALUE-ADDITION INTERMEDIARIES FOR MAIZE**

Based on visits with various commercial grinding mill operators and discussions with FARM staff and key government officials, such as the Agricultural Commissioner of Yei County, the consultant concludes that the configuration, specifications, and end-use of the grinding mills in their current state do not present investment opportunities in terms of equipping the existing mills to produce higher-grade flour as well as absorbing surplus production from local maize farmers. The current capacity of these grinding mills is a maximum of 1,000kg/day at Grade 3 quality. The grinding mills cannot perform beyond those capabilities and the current operators seemed to be busy enough with their existing activities. An intervention to increase value-addition in maize would entail the purchase of more advanced, higher-capacity flour milling equipment and generally lean toward more scaled-up processing and marketing strategies. The next section will illustrate some existing examples of small- to larger-scale production of maize flour.

### **3.4. MEETINGS WITH FLOUR PRODUCERS**

#### **3.4.1. Yei Miller: "Mugabe"**

Mugabe has a small-scale flour mill in Yei town, which he owns and operates with three other partners. He only produces Grade 2 quality flour for the local market and does not offer any grinding services. Mugabe's mill runs off an electric motor that rotates very quickly, as required to produce this quality of flour. His output is small: maximum milling capacity per day is 1,000 kg. A rough representation of his profit and loss is shown on the following page.

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<sup>14</sup> World Food Programme. "South Sudan: Purchase for Progress." October 2012.

Revenue	22 bags/day x 60 SSP/bag x 26 days=34,320 SSP
Costs of raw materials, i.e., primarily purchase of maize kernels (estimate based on numbers provided by owner)	22 bags/day x 50 kg x .70 (30% loss from milling) <sup>15</sup> =770 kg x 26 days x 1.0 SSP/kg (farm gate price)=(20,020) or at 1.5 SSP=(30,030)
Fuel	(7,800 SSP)
Labor	(600 SSP)
Oil change	(200 SSP)
Transportation (to collect maize grain and to take to market.)	These costs were not confirmed with the owner.
Equipment servicing costs (depreciation)-milling costs	
Other costs (taxes, local fees, interest, etc.)	
Profit	5,700 SSP (for grain at 1 SSP/kg) or (4,310 SSP) (for grain at 1.5 SSP/kg)

These rough estimates indicate that the business teeters between marginal profit and significant loss.<sup>16</sup> As these are estimates, the viability of this business seems to hinge largely on whether or not the owner can negotiate a low price on the cost of the grain. When the price of maize grain approaches 1.3 SSP/kg, his business starts to enter into negative profit. Mugabe mentioned that his main challenge is purchasing raw maize, as when he tries to purchase from farmers, they usually renege on their arrangements, and instead sell to the highest bidder of the moment. This was confirmed with the agricultural commissioner; farmers ration out and time the release of their maize to capture the highest price possible. Unfortunately for Mugabe, he needs to negotiate the lowest price possible for the maize, since he still has to factor in transportation, both for purchasing and bringing the maize to market, milling costs, and marketing costs before the flour is sold at the market. Mugabe understands the market and pricing for Grade 2 flour and that he must manage all of his costs so that he does not have a markup that takes him over the retail price of Grade 2 flour. In September 2013, this was 2.6 SSP to 3.0 SSP/kg, which would make him uncompetitive with Ugandan flour. Further inquiry is needed to assess the accuracy of these estimates. The consultant would also like to inquire more about the actual prices Mugabe pays for a ton of shelled maize.

### 3.4.2. Savannah Farmers Cooperative

Savannah Farmers Cooperative (SFC), or SFC Flour Mill, has been supported since 2006. It is the premier flour producer in South Sudan and the largest milling operation to-date. SFC's sole donor is Cal Bombay Ministries Inc. of Canada, which has provided funding for construction of its milling facility, purchase of its milling equipment, purchase of all heavy equipment (tractors and attachments), and provision of the cooperative's current operating capital.

<sup>15</sup> Maize grain processed into Grade 2 flour incurs a 30 percent loss in weight while Grade 1 incurs a 35 to 40 percent loss.

<sup>16</sup> It needs to be confirmed if he mills more than this daily amount of 770kg. This revenue model given by him may be skewed since he might be producing above the 770kg to take his production close to 1,000kg, then his profits may not be underestimated when deducting his fuel, labor, and other costs.

The cooperative is organized into four divisions: 1) Out-Grower Operations, 2) Milling and Marketing, 3) Mechanical, and 4) Farming Operations. SFC is headed by General Managing Director Antoine Duku. He was not present during the field visit.

Based on the information presented by Mr. Simon Peter, Division Manager for Out-Grower Operations, SFC has approximately 1,700 feddans under cultivation with 1,250 feddans contracted with 250 out-grower farmers. SFC purchases the harvested and dried maize from these out-grower farmers. Last year, the cooperative negotiated a price of 3 SSP/kg with its out-grower farmers. SFC provides field technical services to these farmers and plowing services (at a reduced fee). In the previous year, SFC was able to purchase 101 tons from these farmers, but had access to 300 tons. Its donor, Cal Bombay Ministries, provides the operating capital to purchase the raw material, which was estimated at \$75,000 based on the tonnage that SFC purchased. It was alluded to by Mr. Peter that this operating capital is a grant, but he indicated that Cal Bombay is seeking to reduce this funding. Mr. Peter admitted that last year's negotiations with its out-grower farmers could have been done differently and that for this year it might establish some sort of forward contracting arrangement and try to negotiate a price between 1.6 to 2.0 SSP. Mr. Peter also mentioned that the cooperative needs to purchase three new tractors to replace those currently not working, and that it has applied for a loan from Equity Bank.

The mill and marketing manager, Johnson Robinson, presented the milling and marketing side of SFC. The maximum production capacity of its milling operation is seven tons per day, but the main power source (which appears to be a V8 Russian diesel engine) is under repair.<sup>17</sup> The milling operation is driven by a 30 horsepower tractor with a maximum output of two tons per day. The mill produces Grade 2 flour, which it packages in 50 kg, 25 kg, and 10 kg bags. The flour sells at 3 SSP per kg at retail, the prevailing market rate,<sup>18</sup> and sells to schools at approximately 500 bags per order. Local hotels and their in-house sales representatives are each given up to 10 tons, which is usually cleared in a three-week period. Their flour is also sold in Juba.

How the cooperative handles itself as a freestanding, independent business in the near future will be of interest to government officials, development organizations, or the private sector that may consider the formation, operation, and management of this cooperative as a model for private sector development.

### **3.5. POSSIBLE OPPORTUNITIES FOR INTERVENTION**

The number of individuals or entities engaging in grade quality flour production is few, which was confirmed by the consultant during the visits throughout CES. The only functioning flour producers operating are the two previously discussed, Mugabe and SFC, and a flour producing cooperative, Yugapi in Morobo County,<sup>19</sup> established with the assistance of an international organization. The two grinding mill operators discussed above, Locator Cooperative in Morobo County and Twine Mutane in Kajokeji County, both of which expressed an interest in flour milling, could be supported as newly established flour mills with start-up capital to purchase equipment, while an operator like Mugabe could receive operating capital. Major attention and support would be needed to address the following issues:

- Understanding of price behavior and determination at the farm gate of raw materials; devising strategies to lock in prices for materials and aggregating procurements for the processor.

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<sup>17</sup> The cylinder block was removed.

<sup>18</sup> Ugandan maize sells for the same price.

<sup>19</sup> This cooperative was located in a payam not part of the FARM implementation area.

- Conducting a proper and expansive market survey to determine how and by how much the supported flour miller can penetrate existing flour markets based on price and quality. Incorporating this information into a marketing plan would establish the basis for this type of business and aid the flour miller in determining his initial capital needs and how he will organize his cost structure and raw materials.
- Organization and management structure of the flour milling venture, including division of labor. Running this venture as an individual operator would not be feasible.

The development of a business plan should precede any investment and the recipient would undergo significant technical, business, and organizational training. A repayment element for the recipient should be incorporated into the investment plan. Finally, support should be directed to only those actively engaged in grinding and with an understanding of the flour market in South Sudan.

## 4. CONCLUSION

While more investigation of the maize milling potential is required, it is clear that there would need to be significant investment in securing sufficient maize to run the maize mills proposed through NEAT. There appear to be two different types of systems, with the majority of the maize milling being for household subsistence needs. The maize continues to be owned by the person bringing the maize to the mill, who pays a small amount for having the maize ground. These maize mills are hammer mills that grind the corn but do not produce a Grade I commodity; the product has a short storage life. The second option is groups that have tried to produce higher grade flour where they buy the grain from the farmer. These groups have experienced either a shortage of commodity to mill or have paid a price that subsidizes the cost of the maize flour being produced, which is then being sold at the same price as Grade I maize meal from Uganda. It would appear for the time being that the preferred milling system is the hammer mill though this needs to be monitored in the future as local demand for high-quality produce increases.

As cited in the report, maize mills are found along the main roads and in the urban centers. The vast majority of these mills are privately funded and operate for local communities. It is not clear how householders in rural areas process their maize; the rural population in most communities is too sparse and the population often too poor to make a mill economically viable.

Value-addition to South Sudan's key agricultural commodities through processing presents opportunities to diversify beyond the selling of raw commodities into more expanded, ever-more-competitive markets, by providing quality products to the South Sudanese public. The current status of agro-processing at the county level indicates that raw commodities in processed form (e.g., maize flour) end up primarily in the household; little of this flour circulates in the open market. Strengthening the value chain is essential to provide incentives for farmers to cultivate for the market, for processors to produce high quality maize flour, and for retailers to market this flour competitively against other brands.

# APPENDIX I: CODE BOOK FOR MAIZE FLOUR MILLS IN CENTRAL EQUATORIA STATE

## SECTION A: HISTORICAL PROFILE

QA1. Name of Mill: (text) \_\_\_\_\_

QA2. Name of State: (dropdown list)

- a. Central Equatoria
- b. Eastern Equatoria
- c. Western Equatoria

QA3. Name of County: (dropdown list) as required

- a. Kajokeji
- b. Morobo
- c. Yei

QA4a. Payams in Kajokeji County: (dropdown list)

- a. Liwolo
- b. Nyepo
- c. Kangapo 1
- d. Kangapo 2
- e. Lire

QA4b. Payams in Morobo County: (dropdown list)

- a. Panyume
- b. Gulumbi
- c. Kimba
- d. Lujulo
- e. Wudabi

QA4c. Payams in Yei County: (Dropdown list)

- a. Lasu
- b. Otogo
- c. Mugwo
- d. Tore

e. Yei Town

QA5a1. Name of Boma in Liwolo: (text)

**NB:** No proper lists of Bomas exist and also Boma being the last location unit from which we can proceed to next questions.

QA5a2. Name of Boma in Nyepo: (text)

QA5a3. Name of Boma in Kangapo1: (text)

QA5a4. Name of Boma in Kangapo2: (text)

QA5a5. Name of Boma in Lire: (text)

QA5b1. Name of Boma in Panyume: (text)

QA5b2. Name of Boma in Gulumbi: (text)

QA5b3. Name of Boma in Kimba: (text)

QA5b4. Name of Boma in Lujulo: (text)

QA5b5. Name of Boma in Wudabi: (text)

QA5c1. Name of Boma in Lasu: (text)

QA5c2. Name of Boma in Otogo: (text)

QA5c3. Name of Boma in Mugwo: (text)

QA5c4. Name of Boma in Tore: (text)

QA5c5. Name of Boma in Yei Town: (text)

QA6. GPS coordinate (in degree decimal): Latitude\_\_\_\_\_ Longitude\_\_\_\_\_ (encrypted digitally)

QA7. Data collection date: (dd/mm/yyyy)

QA8. Data collector: (text)

QA8. Year machine first installed: (Month and Year)

QA9. Year in operation: (text)

QA10a. Ownership

- a. Private individual
- b. Private group
- c. Cooperative
- d. Community-owned
- e. NGO-donated

If donated by NGO, Go to Q10b.

Q10b1. Name of NGO/Donor: (text)

Q10b2. Address (City) of NGO/donor: (text)

## **SECTION B: MANAGEMENT STRUCTURE**

QB1. Have management structure: (dropdown list)

- a. Yes
- b. No

If Yes, complete QB2. And if No, skip to QC1

QB2a. Name of President/Chairperson: (text)

QB2b. Name of V President/Chairperson: (text)

QB2c. Name of Secretary: (text)

QB2d. Number of Committee members: (text)

QB2e. Number of Board of Directors: (text)

## **SECTION C: TECHNICAL MANAGEMENT COMMITTEE**

QC1. Have technical: (dropdown list)

- a. Yes
- b. No

If Yes, Complete QC2. And if No, skip to QD

QC2a. Name of General Manager: (text)

QC2b. Name of Marketing/Branding Manager: (text)

QC2c. Number of technician (Integer)

QC2d. Number of Operators: (Integer)

QC2e. Number of Cashiers (Integer)

QC2f. Name of Procurement Manager (text)

QC2g. Number of Logisticians (Integer)

QC2h. Number of storekeepers (Integer)



## **SECTION D: STARTUP CAPITAL**

QD1. Sources of startup capital: (dropdown list)

- a. Own savings
- b. Group contribution
- c. Grants from agency/NGO
- d. Loan from financial institution

QD2. Amount of startup capital: (currency)

## **SECTION E: CAPACITY OF THE MILL**

QE1a. Type of mill: (text)

QE1b. Model of the mill: (text)

QE2. Size (Horsepower): (Integer)

QE3. Potential capacity of milling in Kg per day: (Fractional number)

QE4. Current milling capacity in Kg per day: (Currency)

## **SECTION F: OPERATING COST PER MONTH**

QF1a. Cost of fuel per month: (Currency)

QF1b. Cost of oil per month: (Currency)

QF1c. Cost of service and maintenance per month: (Currency)

QF2a. Wages and labor per month: (Currency)

QF2b. Cost of Vehicle Hire/Operation per month: (Currency)

## **SECTION G: REVENUE STREAM PER MONTH**

QG1. Type of Maize product available in store: (dropdown list)

- a. Grade 1 Product
- b. Grade 2 Product
- c. Residue

If select a, GOTO QG2a. If select b, GOTO QG3a. If select c, GOTO QG4a

QG2a. Quantity of Grade 1 product available in store: (Fractional Number)

QG2b. Quantity of Grade 1 product available for sale: (Fractional Number)

QG2c. Quantity of Grade 1 product sold per month: (Fractional Number)

QG2d. Price of Grade 1 product per Kg per month: (Currency)

QG3a. Quantity of Grade 2 product available in store: (Fractional Number)

QG3b. Quantity of Grade 2 product available for sale: (Fractional Number)

QG3c. Quantity of Grade 2 product sold per month: (Fractional Number)

QG3d. Price of Grade 2 product per Kg per month: (Currency)

QG4a. Quantity of Residue available in store: (Fractional Number)

QG4b. Quantity of Residue available for sale: (Fractional Number)

QG4c. Quantity of Residue sold per month: (Fractional Number)

QG4d. Price of Residue per Kg per month: (Currency)

## **SECTION H: TECHNICAL CAPACITY**

QH1a. The cleaning process in this mill is: (dropdown list)

- a. Manual
- b. Automatic

QH1b. The cleaning process involves: (dropdown list)

- a. Addition of water
- b. De-stoner
- c. Magnets

QH2. The mill does conditioning: (dropdown list)

- a. Yes
- b. No

QH3a. The mill operators are confident that they remove Bran to: (dropdown list)

- a. 80%
- b. 90%
- c. 100%

QH3a. The mill operators are confident that they remove Germs to: (dropdown list)

- a. 80%
- b. 90%
- c. 100%

QH3a. The mill operators are confident that they retain Endosperm to: (dropdown list)

- a. 80%
- b. 90%
- c. 100%

## SECTION I: PHYSICAL CONDITION OF THE MILL

Q11a. Mill has separate engine room: (dropdown list)

- a. Yes
- b. No

Q11a. Mill has separate grain Store: (dropdown list)

- a. Yes
- b. No

If Yes, GOTO Q12a. If No, SkipTo Q13

Q12a. Capacity of the grain store in MT: (Fractional Number)

Q13. The mill has separate product store: (dropdown list)

- a. Yes
- b. No

If Yes, GOTO Q13a. If No, END

Q13a. Capacity of the product store in MT: (Fractional Number)

# APPENDIX 2: MAIZE MILL SURVEY DATA

S/n	Mill Name	County Name	Latitud	Longitude	Altitude	Year of Instal- lation	Years in Oper- ation	Mill Ownership	Management Strucutre?	Committee Members	Board Members	Technical Management Exists?	# of Technicians	# of Operators	# of Cashiers	# of Logisticians	# of Store-Keepers
1	C	Kajokeji				2003	8	NGO-donated	no			no					
2	C	Kajokeji				2009	4	NGO-donated	yes	3	3	no					
3	Eda martha	Kajokeji				2002	3	Private individual	yes	12	6	yes	1	2	1	3	2
4	Loboja & Sons Granding Mill	Kajokeji	3.804	31.707	920.7	2013	0.166	Private individual	no			no					
5	Lojuan & Brother Ent. Granding Mills	Kajokeji	3.820	31.668	978.5	2010	3	Private individual	no			no					
6	Loboka & Sons Granding Mill	Kajokeji	3.802	31.717	921.7	2008	6	Private individual	no			no					
7	Mogan & Sons Ent.	Kajokeji	3.821	31.669	998.0	2007	6	Private individual	no			yes	2	2	1		
8	Wani Granding Mill	Kajokeji	3.802	31.717	923.4	2011	2	Private individual	no			yes	1	1	1		
9	Savannah Flour Mills	Kajokeji	3.778	31.514	900.2	2011	1	cooperatives	yes	8	7	yes	5	8	2	1	1
10	Lwokit maize mill	Kajokeji	3.882	31.666	943.4	2008	4	Private individual	no			no					
11	Akena maize mill	Kajokeji	3.887	31.669	990.3	2011	2	Private individual	no			no					
12	Durjita maize mill	Kajokeji	3.871	31.666	941.6	2011	2	Private individual	no			no					
13	Mugomoro maize mill	Kajokeji	3.777	31.513	880.2	2008	5	Private individual	no			no					
14	Lokojo Grading Mill	Kajokeji	3.830	31.658	985.3	2007	6	Private individual	no			no					
15	Tiok and sons	Kajokeji	3.814	31.629	964.3	2013	0.25	Private individual	no			no					

S/n	Mill Name	County Name	Latitud	Longitude	Altitude	Year of Instal-lation	Years in Oper-ation	Mill Ownership	Management Strucutre?	Committee Members	Board Members	Technical Management Exists?	# of Technicians	# of Operators	# of Cashiers	# of Logisticians	# of Store-Keepers
16	Mundari nabule mill	Kajokeji	3.854	31.658	946.6	2013	0.0625	Private individual	yes	3	5	yes	1	1	1		
17	Bojoli Bojo and Son	Kajokeji	3.848	31.657	939.8	2013	0.25	Private individual	yes	4	3	yes	2	2	1	1	1
18	Mundare nabule maize miller	Kajokeji	3.854	31.658	928.0	2013	0.0625	Private individual	yes	3	5	yes	1	1	1		
19	Lobia and sons	Kajokeji	3.847	31.657	940.0	2010	3	Private individual	yes	3	4	yes	3	2	1	3	2
20	Ide maize mill	Kajokeji	3.771	31.493	863.2	2010	3	Private individual	no			no					
21	Solomona Granding Mill	Kajokeji	3.907	31.632	954.5	2012	1	Private individual	no			no					
22	Lire Granding Mill Ltd	Kajokeji	3.893	31.619	954.8	2010	3	Private individual	no			yes	2	1	1	1	
23	Osman Kaya Granding mill	Kajokeji	3.883	31.640	924.6	2012	0.416	Private individual	no			no					
24	Bekate Granding Mill	Kajokeji	3.878	31.640	926.9	2012	1	Private individual	no			no					
25	Longira Grinding Mill	Kajokeji	3.880	31.602	905.8	2009	4	Private individual	no			no					
26	Wani Grinding Mill	Kajokeji	3.804	31.732	910.9	2013	0.333	Private individual	no			no					
27	Dumo Grinding Mill	Kajokeji	3.738	31.683	989.5	2012	1	Private individual	no			no					
28	Tomijo Grinding Mill	Kajokeji	3.727	31.633	896.1	2010	3	Private individual	no			no					
29	Joice Kenyi Grinding Mill	Kajokeji	3.726	31.683	957.7	2007	6	Private individual	no			no					
30	Gabriel Grinding Mill	Kajokeji	3.723	31.659	1016.7	2011	2	Private individual	no			no					
31	Saani maize mill	Kajokeji	3.829	31.580	911.9	2008	5	Private individual	no			no					
32	Temondi maize mill	Kajokeji	3.808	31.594	937.1	2012	1	Private individual	no			no					

S/n	Mill Name	County Name	Latitud	Longitude	Altitude	Year of Instal- lation	Years in Oper- ation	Mill Ownership	Management Strucutre?	Committee Members	Board Members	Technical Management Exists?	# of Technicians	# of Operators	# of Cashiers	# of Logisticians	# of Store- Keepers
33	United consumers maize mill	Kajokeji	3.828	31.579	911.6	2005	8	Private individual	yes	2	2	no					
34	Dumba maize mill	Kajokeji	3.844	31.563	869.4	2007	5	Private individual	no			no					
35	Majo and brothers maize mill	Kajokeji	3.772	31.636	903.3	2000	12	Private individual	no			no					
36	Elijagonda maize mill	Kajokeji	3.776	31.667	1022.8	2011	2	Private individual	no			no					
37	Kinyi investment maize mill	Kajokeji	3.815	31.667	979.8	2012	0.583	Private individual	no			no					
38	Morjan and sons mill	Kajokeji	3.843	31.677	970.7	2008	5	Private individual	no			no					
39	Lobiju maize mill	Kajokeji	3.845	31.680	967.2	2012	1	Private individual	no			no					
40	ELok maize mill	Kajokeji	3.753	31.595	887.8	2009	4	Private individual	no			no					
41	Loke maize mill	Kajokeji	3.754	31.596	878.6	2011	2	Private individual	no			no					
42	Rebacca Tege mill	Kajokeji	3.861	31.537	837.1	2009	3	Private individual	no			no					
43	Saani mill	Kajokeji	3.786	31.567	892.2	2011	2	Private individual	no			no					
44	Arus maize mill	Kajokeji	3.776	31.513	884.8	2010	3	Private individual	no			no					
45	Gunyo mill	Kajokeji	3.680	31.549	810.0	2007	6	Private individual	no			no					
46	Gunyo mill	Kajokeji	3.712	31.570	864.2	2012	0.666	Private individual	no			no					
47	Dk	Morobo	4.859	31.596	456.9	2010	3	Private individual	yes	6	3	yes	2	2	2	2	2
48	Alphon	Morobo				2002	3	Private individual	yes	8	2	yes	2	2	1	2	1
49	B	Morobo				2013	0.166	Cooperatives	no			no					
50	Amec	Yei	3.863	30.756	941.6	2012	1	Private individual	no			no					
51	Jombu grinding mill	Yei				2011	1	Private individual	yes	5	5	yes	3	3	1	1	1
52	Yei	Yei				2011	2	Private individual	no			no					

S/n	Mill Name	County Name	Latitud	Longitude	Altitude	Year of Instal-lation	Years in Oper-ation	Mill Ownership	Management Strucutre?	Committee Members	Board Members	Technical Management Exists?	# of Technicians	# of Operators	# of Cashiers	# of Logisticians	# of Store-Keepers
53	Ags	Yei	4.859	31.596	466.8	2012	1	Private individual	no			no					
54	Amc	Yei				2009	3	Private individual	no			yes	2	1	1	1	1
55	Waranga	Yei	4.859	31.596	467.3	2011	2	Private individual	no			no					
56	A	Yei				2000	13	ngodonated	no			no					
57	Tombe laku	Yei				2002	3	Private individual	yes	12	6	yes	2	3	1	3	4
58	Moses Onyango	Yei				6/6/13	0.5	Private individual	yes	13	12	yes	1	1	1	12	1
59	Jombo	Yei	3.807	30.782	1084.2	2012	1	Private group	yes	7	7	yes	2	2	1	2	1
60	Ablometa	Yei	3.836	30.771	1046.5	2012	1	cooperatives	yes	35	3	no					
61	No name	Yei	4.086	30.680	789.7	2012	1	Private individual	yes	3	3	yes	1	2	1	0	0
62	No name	Yei	4.086	30.680	814.8	2012	1	Private individual	no			yes	2	2	1	1	0
63	No name	Yei	4.097	30.681	794.6	2013	0.25	Private individual	no			yes	1	2	1	1	0
64	Natash	Yei	4.086	30.680	804.9	2013	0.25	Private individual	no			no					
65	Lister peter	Yei	4.086	30.680	797.4	2013	0.166	Private individual	no			no					
66	Jia	Yei	4.087	30.680	794.1	2010	3	Private individual	yes	6	1	no					
67	Jeme	Yei	4.097	30.681	806.5	2013	0.166	Private individual	no			no					
68	No name	Yei	4.086	30.680	797.5	2012	2	Private individual	no			no					
69	No name	Yei	4.088	30.664	833.6	2007	6	Private individual	no			yes	2	2	1	0	0
70	No name	Yei	4.084	30.656	843.9	2012	0.333	Private group	no			no					
71	No name	Yei	4.097	30.681	807.2	2013	0.333	Private individual	no			no					
72	Sadia grinding mill	Yei	4.097	30.681	800.2	2004	8	Private individual	yes	3	5	yes	2	2	1	0	1
73	God does not forget opherns	Yei	4.097	30.681	788.4	2009	3	Private individual	no			no					
74	No name	Yei	4.097	30.681	786.2	2011	2	Private individual	no			yes	3	2	1	0	0

S/n	Sources of Start-up Capital	Mill Type	Mill Model	Mill Cleaning Process	Method of Mill Cleaning	Mill in Good Condition?	Bran Removal (%)	Endosperm Removal (%)	Engine Room Available?	Grain Store Available?
1	Own capital & grants from agency	Honda	Bmk41	Manual		no	80	90	no	yes
2	Own capital & grants from agency	Honda	Ak44	Manual		no	80	100	yes	yes
3	Other sources	Nokia	Ct	Manual	Destoner	yes	80	80	yes	yes
4	Own capital	Jiangdong	ZH1105	Manual		no			no	no
5	Own capital	Nissan	TD27	Manual		no	80	80	no	no
6	Own capital	Yangdong	S1100	Manual		no	80		no	no
7	Own capital	Nissan	TD27	Manual		no	80	80	no	no
8	Own capital	Jiangdong	ZH1110	Manual		no			no	no
9	Own capital & other sources	Lister Engine Driving Mill	C3	Manual	Addition of water	yes	80	90	yes	yes
10	Own capital	Johnston	TFe23.2007	Manual	Addition of water	no	80	80	no	no
11	Own capital	Nissan	NE23	Manual	Addition of water	no	80	80	no	no
12	Own capital	Nissan diesel	HB95	Manual		no	80	80	no	no
13	Own capital	Amxe	Jiangdong	Manual		no	80	80	no	no
14	Own capital	Nissan	TT27	Manual		no	80	80	no	yes
15	Own capital	Jiangdong	Zh1110wp	Manual		no	80	80	no	no
16	Own capital	NissanTT27	M216809	Manual		no	80	80	no	yes
17	Own capital	Jiangdong	Zh1110wp	Manual		no	80	80	no	yes
18	Own capital	NissanTT27	M216809	Manual		no	80	80	no	yes
19	Own capital	Nisan	Tt27	Manual		no	80	80	no	no
20	Own capital	Nissan	Nf24	Manual		no	80	80	no	no
21	Own capital	AMEG	S1100B	Manual	Addition of water	no			no	no
22	Own capital	Johnstone	S1110P	Manual	Addition of water	no	80		no	no
23	Own capital	Jiangdong	ZH1110	Manual	Addition of water	yes			no	no
24	Own capital	JiangDong	ZH1115WP	Manual	Addition of water	no			no	no
25	Own capital	Vertical	SF-100H	Manual	Addition of water	no			no	no
26	Own capital	Nissan	NF 12	Manual	Addition of water	no			no	no
27	Own capital	Yangdong	ZS1115	Manual	Addition of water	no			no	no



S/n	Sources of Start-up Capital	Mill Type	Mill Model	Mill Cleaning Process	Method of Mill Cleaning	Mill in Good Condition?	Bran Removal (%)	Endosperm Removal (%)	Engine Room Available?	Grain Store Available?
28	Own capital	Yangdong	S1110B	Manual	Addition of water	no			no	no
29	Own capital	Yangdong	S1110	Manual	Addition of water	no			no	no
30	Own capital	Johnston	S1110P	Manual	Addition of water	no			no	no
31	Own capital	AMR ZS1113 diesel engine	Small weight	Manual	Addition of water	no	80	80	no	no
32	Own capital	Nissan dwseal	NF14	Manual	Addition of water	no	80	80	no	no
33	Group contribution	AMEC Diesel	S1110B	Manual	Addition of water	no	80	80	no	no
34	Own capital	AMEC Diesel Engine	ZH1115wp	Manual	Addition of water	no	80	80	no	no
35	Own capital	Nissan Diesel engine	DH111105w	Manual	Addition of water	no	80	80	no	no
36	Own capital	Jiangdong maize mill	ZS1110	Manual	Addition of water	no	80	80	no	no
37	Own capital	Johnston maize mill	S195	Manual	Addition of water	no	80	80	no	no
38	Own capital	Johnston maize mill	ZS1110 diesel engine	Manual	Addition of water	no	80	80	no	no
39	Own capital	Yiangdong mill	ZS1110	Manual	Addition of water	no	80	80	no	no
40	Own capital	Yiangdong	Zs195	Manual	Addition of water	no	80	80	no	no
41	Own capital	Yiangdong	S1110B	Manual	Addition of water	no	80	80	no	no
42	Own capital	Jiangdong	ZH1110wB2	Manual	Addition of water	no	80	80	no	no
43	Own capital	Johnston diesel	S1110p	Manual	Addition of water	no	80	80	no	no
44	Own capital	Jiangdong	Zs1110	Manual	Addition of water	no	80	80	no	no
45	Own capital	Nissan	Z1110wp	Manual	Addition of water	no	80	80	no	no
46	Own capital	Nissan	Zs1110wp	Manual	Addition of water	no	80	80	no	no
47	Own capital	Gk7	C62	Manual		no	80	80	yes	yes
48	Other sources	Yahama	Gsd	Manual	Addition of water	yes	100	100	yes	yes
49	Own capital	Ts2	E22	Automatic	Magnets	yes	80	80	yes	yes
50	Own capital	Natasha	175010230	Manual	Addition of water	yes	80	80	no	no
51	Own capital & other sources	Johnson diesel	S1100p	Manual	Destoner	yes	80	80	yes	yes
52	Own capital, loan &	Honda	Gt22	Automatic	destoner	yes	80	80	yes	yes

S/n	Sources of Start-up Capital	Mill Type	Mill Model	Mill Cleaning Process	Method of Mill Cleaning	Mill in Good Condition?	Bran Removal (%)	Endosperm Removal (%)	Engine Room Available?	Grain Store Available?
	other sources									
53	Own capital	Gsk	Kjh	Manual	Addition of water	yes	80	90	yes	yes
54	Own capital & other sources	Ab3	Aed	Manual	Destoner	yes	80	90	yes	yes
55	Own capital & other sources	Honda	DC33	Automatic	destoner	yes	80	80	yes	yes
56	Loan	Honder	200	Manual	Addition of water	yes	90	90	yes	yes
57	Own capital, loan & other sources	Honda	DD33	Automatic	destoner	yes	90	90	no	no
58	Own capital & other sources	Yamaha	Cct3	Automatic	Magnets	no	100	100	no	yes
59	Own capital & group contribution	Johnston Diesel	S10012	Automatic	destoner	yes	90	90	yes	yes
60	Group contribution	Jd	121011260450	Manual	Addition of water	yes	80	80	yes	no
61	Own capital	Changfa	Zs110GP	Manual	Addition of water	yes	80	80	no	no
62	Own capital	AMEC	S1110B diesel	Manual	Destoner	yes	80	80	no	no
63	Own capital	Turbo	DT27	Manual	Addition of water	yes	80	80	no	no
64	Own capital	Vertical	Slip 100h	Manual	Destoner	no	80	80	no	no
65	Own capital	England	England made	Manual	Addition of water	yes	80	80	no	no
66	Other sources	Amec	2010	Manual	Destoner	yes	80	80	no	no
67	Own capital	Y2225s	H250	Manual	Addition of water	yes	100	100	no	no
68	Own capital	Yungdog	S110	Manual	Destoner	yes	80	80	no	no
69	Own capital	Yungdong	S1110 diesel	Manual	Destoner	yes	80	80	no	no
70	Group contribution	Nisan	No model	Manual	Destoner	yes	80	80	no	no
71	Own capital	Amec	180018622	Manual	Addition of water	yes	80	80	no	no
72	Own capital	Nisan diesel	TD23	Manual	Destoner	yes	80	80	no	no
73	Own capital	Mister	171580	Manual	Addition of water	no	80	80	no	no
74	Own capital	Nissen	DT27	Manual	Destoner	yes	80	80	no	no

S/n	Amount of Start-up Capital	Mill Potential	Used	Cost of Fuel	Cost of Oil	Cost of Service	Labor Cost	Cost of Hired Vehicle	Maize Production	Qty of Grade 1 in Store	Qty. of Grade 1 for Sale	Qty of Grade 1 Sold	Qty of Grade 2 in Store	Qty of Grade 2 for Sale	Qty of Grade 2 Sold	Qty of Grade 3 in Store	Qty of Grade 3 for Sale	Qty of Grade 3 Sold	Grain Store Available	Grain Product Stored	Qty of Produce Stored
1	5,600	9,800	4,378	6	4	3	32	4	grade 2				560	560	455				yes	yes	560
2	6,000	8,000	6,750	56,733	2,222	563	7,000	4	grade 2				2	1	1				yes	no	
3	3,000	30	25	3,000	150	1,200	1,800	1,000	grade 2				100	60	120				yes	yes	25
4	17,500	1,000	460	280	45	180	200	0	residue										no	no	
5	15,000	2,000	200	1,600	160	300	0	0	residue										no	no	
6	15,000	2,500	90	600	45	80	160	0											no	no	
7	15,000	2,000	80	2,400	96	100	200	0	grade 2										no	no	
8	14,000	3,000	100	300	45	100	0	0											no	no	
9	55,000	7,000	3,000	28,800	1,100	12,260	2,100	540	grade 2				3,000	3,000	46,500				yes	yes	40,000
10	7,500	3,000	800	640	120	0	100	0	grade 2										no	no	
11	10,000	2,000	200	640	280	240	270	0	grade 2										no	no	
12	13,000	3,000	200	480	140	0	300	0	grade 2										no	no	
13	4,000	3,000	100	1080	140	350	300	0	grade 2										no	no	
14	12,000	4,000	2,500	480	65	140	100	0	residue										yes	no	
15	7,000	1,500	358	140	36	150	400	50	grade 2										no	no	
16	30,000	2,000	200	2,100	180	240	150	350	grade 2										yes	no	
17	15,000	800	500	2,100	160	200	200	0	grade 2										yes	no	
18	30,000	2,000	200	2,100	180	240	150	350	grade 2										yes	no	
19	1,000	3,000	500	2,240	330	160	160	0	grade 2										no	no	
20	14,000	2,000	300	1,400	240	300	200	0	grade 2										no	no	
21	12,000	3,000	250	320	80	300	100	0											no	no	
22	10,000	2,000	500	1,600	160	100	400	0											no	no	
23	13,000	1,000	180	100	90	0	0	0											no	no	
24	12,000	1,500	60	80	48	50	120	0	residue										no	no	
25	13,000	2,000	200	640	80	150	140	0											no	no	
26	19,000	1,500	200	160	90	0	0	0											no	no	

S/n	Amount of Start-up Capital	Mill Potential	Used	Cost of Fuel	Cost of Oil	Cost of Service	Labor Cost	Cost of Hired Vehicle	Maize Production	Qty of Grade 1 in Store	Qty. of Grade 1 for Sale	Qty of Grade 1 Sold	Qty of Grade 2 in Store	Qty of Grade 2 for Sale	Qty of Grade 2 Sold	Qty of Grade 3 in Store	Qty of Grade 3 for Sale	Qty of Grade 3 Sold	Grain Store Available	Grain Product Stored	Qty of Produce Stored
27	12,000	1,000	100	340	180	200	50	0											no	no	
28	9,000	1,000	100	320	80	300	160	0											no	no	
29	12,000	2,000	50	640	80	400	80	0	residue										no	no	
30	14,000	2,000	800	1,600	160	300	180	0											no	no	
31	5,000	5,000	200	1,000	480	0	150	0	grade 2										no	no	
32	6,000	2,000	200	75	65	300	100	0	grade 2										no	no	
33	4,500	1,200	200	300	75	200	300	0	grade 2										no	no	
34	7,500	1,500	200	400	75	300	100	0	grade 2										no	no	
35	9,000	2,000	400	700	140	75	90	0	grade 2										no	no	
36	9,000	500	100	480	80	250	60	0	grade 2										no	no	
37	10,000	2,000	150	140	80	0	0	0	grade 2										no	no	
38	10,000	1,200	300	80	60	120	120	0	grade 2										no	no	
39	5,000	1,000	300	140	48	0	0	0	grade 2										no	no	
40	7,000	1,000	60	320	23	500	25	0	grade 2										no	no	
41	9,000	2,000	200	320	36	300	25	0	grade 2										no	no	
42	5,000	1,000	300	320	96	150	100	0	grade 2										no	no	
43	7,400	1,000	200	320	75	250	100	0	grade 2										no	no	
44	7,000	5,000	500	480	130	350	270	0	grade 2										no	no	
45	8,000	1,000	100	420	105	210	100	0	grade 2										no	no	
46	8,000	4,000	200	480	105	210	100	0	grade 2										no	no	
47	600	20,000	150	60	20	60	1,000	600	grade 2				500	500	50				yes	yes	500
48	5000	140	20	3,000	1,000	1,200	7,000	15,000	grade 2				120	100	24				yes	yes	10
49	500	800	8,889	300	450	600	1,000	190	grade 1	80.6	55	55							yes	yes	9,000
50	2,000	200	20	500	50	50	0	0	grade 1	50	0	0							no	no	
51	3,200	160	100	1400	120	300	1,300	700	residue							300	300	300	yes	yes	2,000
52	100,00	50	30	3000	500	1500	2,000	1000	residue							35	25	160	yes	yes	2

S/n	Amount of Startu-up Capital	Mill Potential	Used	Cost of Fuel	Cost of Oil	Cost of Service	Labor Cost	Cost of Hired Vehicle	Maize Production	Qty of Grade 1 in Store	Qty. of Grade 1 for Sale	Qty of Grade 1 Sold	Qty of Grade 2 in Store	Qty of Grade 2 for Sale	Qty of Grade 2 Sold	Qty of Grade 3 in Store	Qty of Grade 3 for Sale	Qty of Grade 3 Sold	Grain Store Available	Grain Product Stored	Qty of Produce Stored
53	2,000	400	300	500	200	300	500	60	grade 1	500	200	400							yes	yes	52
54	10,000	100	45	500	500	300	4000	500	residue							130	80	40	yes	yes	9
55	5,000	50	35	1,500	950	800	750	250	residue							30	25	80	yes	yes	2
56	400	85	4	400	4,000	400	200	0	grade 1	20	80	90							yes	yes	40
57	3,000	26	36	3,000	300	500	2000	388	grade 2				200	150	125				no	no	
58	3,000	123	21	3,000	233	1,200	1,233	655	residue							100	40	23	yes	no	
59	5,000	180	100	700	450	500	1500	600	grade 2				0	0	0				yes	yes	2
60	10,000	175	100	450	80	300	10	10	grade 1	0	0	0							no	no	
61	5,000	180	80	196	54	100	600	0	residue							0	0	0	no	no	
62	7,000	185	900	200	60	200	900	0	residue							0	0	0	no	no	
63	8,000	180	120	420	75	200	750	100	residue							0	0	0	no	no	
64	3,000	100	50	50	70	0	0	0	grade 1	0	0	0							no	no	
65	16,000	50	20	300	350	500	300	0	grade 1	0	0	0							no	no	
66	14,000	700	20	210	135	0	1,800	0	grade 1	0	0	0							no	no	
67	1,500	50	60	0	0	0	600	0	residue							0	0	0	no	no	
68	8,000	180	100	500	75	500	250	250	residue							0	0	0	no	no	
69	13,000	180	300	450	75	200	150	0	residue							0	0	0	no	no	
70	6,000	20	50	40	50	0	0	0	grade 1	0	0	0							no	no	
71	7,000	100	50	500	32	0	0	0	grade 1	0	0	0							no	no	
72	7,000	2,000	1,500	2,100	75	700	300	0	residue							0	0	0	no	no	
73	12,000	50	170	520	500	0	300	0	grade 1	0	0	0							no	no	
74	9,000	3,000	2,500	1,500	75	500	280	0	residue							0	0	0	no	no	